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Stefan Contstable, PhD
Barbara Palmer
Mark Rayson
Andrew S. Jackson, et. al.

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inside:

Special Issue: Physical Fitness Standards Development SOAR

Job Performance

Fitness Test	Can Do	Cannot Do	
Pass	A True Positives	False Positives	A + Positive predictive value = $\frac{A}{A +}$
Fail	C False Negatives	D True Negatives	C + D Negative predictive value = $\frac{D}{C + D}$
	A + C Sensitivity = $\frac{A}{A + C}$	+ D Specificity = $\frac{D}{+ D}$	

The real goal of any testing standard approach is to maximize the correct predictions of (job) success or failure (cells A & D) and minimize the incorrect assessments (cells B & C). This is a notional example of a contingency table and is analogous to the classical truth table used in testing the null hypothesis (H0) for Type I (α) and Type II (b) error. There are many ways to "cut the pie", and this depiction well represents a major theme of this SOAR: The primary goal of developing highly valid test standards can become surprisingly challenging.

The Process of Physical Fitness Standards Development

Stefan Constable, Ph.D.
Chief, Performance Enhancement Division
USAF School of Aerospace Medicine

The ancient Greeks set great value on the physical fitness of the individual, which was considered to be related to success in war and the basis for good health. More recently there has been considerable interest both in job performance and standards for physical fitness, especially within the modern Armed Services. The strong association between increased levels of physical fitness and decreased morbidity and mortality has also been increasingly recognized over the several decades. Overall, individuals may regard fitness in a more varied fashion depending on personal interests, occupation, sex and age, but these idiosyncrasies (or individual views) generally extrapolate well to the physical, social and psychological well being of the human organism.

continued on next page

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For further information, please contact:

Stefan Constable, Ph.D.
Chief, Performance Enhancement Division
USAF School of Aerospace Medicine
2602 West Gate Road
Brooks AFB, TX
78235-5252

stefan.constable@brooks.af.mil

Personally, as one's exposure to this field progresses, it has become exceedingly intriguing, both with regard to the supporting science, as well as the practical implementation of the fitness standards process itself. This interest and quest for more information ultimately led to the evolution of "The Process of Physical Fitness Standards Development" state-of-the-art report (SOAR). Thus, this SOAR attempts to document the methods, processes, and issues that are involved with the development of physical fitness standards with special reference to the military. This Gateway presents seven separate synopses from that SOAR, with each article summarizing a chapter.

Overall, there is a general acceptance regarding a level of required mental performance for entry or advancement in the formal education process. Various organizations have sought to establish both mental and physical standards for job candidate assignment and worker retention in order to ensure job performance and safety. The processes, however, are hardly as straightforward or black and white as most might envision. For example, H.E. Johnson (circa 1946) suggested:

Quantitative assessment of physical fitness is one of the most complex and controversial problems in applied physiology. The situation arises in part from lack of general agreement on what constitutes fitness for withstanding various types of stress, and in part from lack of agreement on what measurements allow valid comparisons to be made among different individuals exposed to the same stress.

In fact, it has been recommended that perhaps both good science and good judgment are required in equal measure. Ideally, the incorporation of standards for acceptable performance on tests of physical capacity should be scientifically (and legally) defensible! However, the "rigors of review" may sometimes be relaxed. For example, performance on current military fitness tests often does not correlate well with task specific, job requirements, especially those involving muscular strength, i.e., heavy lifting or carrying. Current law enforcement and fire fighter programs may often suffer from these same shortfalls.

Relatively few new initiatives have been identified or implemented by the services to update and improve their approach to the fitness standards process, particularly with regard to occupational performance and health considerations. This may in part be due to the lack of a better-organized and published base of knowledge concerning the primary issues of standards development. Therefore, an underlying theme in this text is that the scientific process to establish defensible standards can be complex and subject to interpretation and challenge. More specifically, it may not always be possible to achieve the desired degree of test validity. For example, cost-benefit concerns and resource considerations may be overly constraining in certain settings relative to the expected outcomes, i.e., only modest test sensitivity and specificity is actually achieved. So in practice, the process can be varied or abbreviated and may, at times, involve rather arbitrary final decisions.

Setting resource considerations aside, future advances in this arena may only come from more novel analytical approaches, like a multivalued logic or "fuzzy logic" approach (very briefly a "fuzzy set" ties a curve or a point in a cube to a concept, which may better equate to our "common sense"). For example, it has been argued by animate (versus inanimate) systems theorists that conventional mathematics (precisely defined points, functions, etc.) are not adequate for coping with the analysis of biological systems. Further, to deal with the much more complex human system, radically different kinds of mathematics are warranted. Such an approach would incorporate less distinct or fuzzy quantities that do not lend themselves to the more conventional parameters of probability distributions. And other "out of the box" decision analysis approaches to this problem may evolve as well.

In summary, this reference document strives to provide an organized base of knowledge concerning the primary issues of standards development as they might apply to both the military and civilian environments. Much of the material is technically in-depth, but certain segments lend themselves to larger target audiences as well. Chapters written by academic, industry, or military subject-matter experts cover all of the key topics that are relevant to this field. These specific contributing authors bring a unique breadth of background and experience from the academic, military, industrial and laboratory fields. Ultimately, the goal is to make decisions concerning this process through the judicious identification, evaluation and application of the most relevant information. ■

This issue features excerpts from the recently published state-of-the-art report (SOAR) "The Process Fitness Standards Development," a joint project of the HSIAC Program Office and Dr. Stefan Constable of the Performance Enhancement Division of the U.S. Air Force School of Aerospace Medicine. This SOAR was written by military and civilian subject matter experts in order to promote a more systematic and meaningful approach in the development of physical fitness standards.

Looking For A: Human Factors Engineer/Psychologist

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Bruce Wright, LtCol, USAF, BSC, Ph.D.
Performance Enhancement Division
USAF School of Aerospace Medicine
2602 West Gate Road, Building 775
Brooks AFB, TX 78235-5252

Phone: (210) 536-4612
Fax: (210) 536-3683

History of Occupational Demands Measurement and the Services' Physical Fitness Programs

Barbara Palmer
Human Systems Information Analysis Center (HSIAC)

For further information, please contact:

Barbara Palmer
AFRL/HEC/HSIAC
2261 Monahan Way
Building 196
Wright-Patterson AFB, OH
45433-7022

barbara.palmer@
wpafb.af.mil

Military fitness has been an issue for as long as militia have existed. A progression of quantitative approaches to workplace activities has led to today's interest in establishing occupational fitness standards. Among the early researchers was Frederick W. Taylor (Taylor, 1923), who espoused the practice of scientific management. Taylor was able to use this method to form the basis for training, performance measurement, incentives, and compensation. Following Taylor's quantitative view of the workplace were Lillian and Frank Gilbreth, who developed a related concept, that of motion study (Gilbreth, 1901). The greatest contribution to occupational assessment methodology during recent decades was Edwin Fleishman's work (1964). Fleishman conducted the first systematic research to determine the number of attributes necessary to generate an adequate taxonomy of physical performance.

Parallel efforts in the field of applied scientific psychology during the late 1880s to the early 1900s were focused on understanding and measuring differences among individuals, a field known as psychometrics. In the late 1880s, Francis Galton gathered data on both physical and psychological characteristics (Thorndike & Hagan, 1969), being interested first in techniques of precise measurement and secondarily in the development of statistical procedures with which to make the data meaningful. The work of both Galton and James McKeen Cattell focused on human development, with the hope that assessment of individual traits could be used in educational and vocational arenas.

Fitness standards in the military have been established over the years to promote health and general physical fitness. DoD's guidance, through Department of Defense Directive 1308.1, requires that the services establish a physical fitness and body fat program that includes fitness requirements for all service members (U.S. Department of Defense, 1995). This guidance requires that regardless of age, all service members be measured along three dimensions annually: cardiovascular endurance; muscular strength and endurance; and maintenance of body fat within a certain percentage range. The guidance does not specify particular testing activities or minimum required levels of difficulty. Each military service is required to design its own fitness program to meet mission-specific needs (U.S. Department of Defense, 1995) (see Table 1, page 5).

The purpose of job-specific physical performance standards is to ensure that personnel assigned to physically demanding jobs can perform those jobs. Occupational fitness standards indicate the level at which an individual must perform in order to successfully meet job requirements, regardless of body size or gender. The GAO report (Government Accounting Office, 1996) recommended establishing valid performance standards, providing job training, and redesigning job tasks.

Up until the time of its most current program change, the Army established minimum requirements for its Army Fitness Test on data collected in the 1980s (GAO, 1998b). Last year, the Army began to implement new standards that are based on a more statistically valid sample base than in the past. The policy behind the new standards is gender-neutral with minimum requirements generally set on the 8th percentile of actual scores gathered during an Army study in 1995. Maximums are based on 90th percentile scores, and requirements are reduced in five-year age increments. The Army's current maximum body fat for males is 20 percent, increasing by two points for every 10 years after the age of 29. The Army's standards for females were determined by adding 8 percentage points to the male standard for each category. In 1991, the female standards were made less stringent (from 28 to 34 percent to 30 to 36 percent).

Navy standards for fitness test events: 1½ mile run/walk, push-ups, and sit-ups—for men 30 and older are based on distributions of actual scores

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Table 1. Comparison of basic characteristics of the physical programs of the four services.

	Army	Navy	Air Force	Marine Corps
Reference	Regulation 350–41, 600–9, and 600–63, FM 21–20	Instruction 6110.1F	Instruction 40–501 and 40–502	Orders 6100.3J, 6100.10B, and 6100.4F
Objective/ Goal	Combat and operational readiness Healthy life style Military appearance	Optimal health Stamina for optimal readiness	Motivation to train Fit and healthy force	Overall fitness Mission/combat readiness
Components	Aerobic capacity Upper body/trunk strength/endurance Body fat	Aerobic capacity Upper body/trunk strength/endurance Flexibility Body fat	Aerobic capacity *Upper body/trunk strength/endurance Body fat	Aerobic capacity Upper body/trunk strength/endurance Body fat
Test Items	2-mile run Push-up Sit-up Weight-for-Height Standards Body fat by tape (if individual exceeds weight-for-height standards)	1.5-mile run/walk, or 500 yard swim Curl-up Push-up Sit and reach Weight-for-Height Standards Body fat by tape (if individual exceeds weight-for-height standards)	Submax cycle ergometer prediction of VO2 max *Push-up *Ab crunch Weight-for-Height Standards Body fat by tape (if individual exceeds weight-for-height standards)	3-mile run Ab crunch Pull-up (male) Flexed arm hang (female) Weight-for-Height Standards Body fat by tape (if individual exceeds weight-for-height standards)

* Proposed addition, trial period in to CY 2002

among the extant population gathered during the past two years. Earlier minimum requirements (GAO, 1998a) were set at the 10th percentile and maximums at the 90 to 95th percentiles. However, for the run time for women, an arbitrary increment of time was added to the men's standard rather than being based on actual run times of women. The Navy body composition standards are based on the National Institutes of Health definition of obesity. Navy scientists converted the weight-for-height table data into mean body fat percentages of about 22 percent for males and 33 percent for females.

A 1998 GAO report (GAO, 1998b) concluded that Air Force officials had no published studies or other records to document the rationale for their cardiovascular endurance standards, but an informal account of the Air Force's fitness history reveals that the cardiovascular standard was based on limited normative statistics from a population of Air Force men and women in the early 1990s. The population was divided into quintiles. The Air Force is fielding its new strength test, with standards that will likely be based on Army standards with some possible refinements derived during this fielding period. The Air Force is currently considering a two-tier approach to body composition standards. The first tier would deal with health and readiness, and the second tier would represent job specific standards (Wilkinson, Kampert, Blair, Baumgartner, & Constable, 2000).

Marine Corps standards were probably based on 1967 studies showing average 3-mile run times, with maximum times set at the 90th percentile and minimums at the 10th percentile. Studies conducted in 1993 and 1996 revealed about a 3-minute difference in run times between men and women, so this 3-minute difference was added to the men's standard scores to form the standards for females (GAO, 1998a).

The Marine Corps body fat standards appear to be based on command judgments for fitness and appearance, according to the GAO (GAO, 1998a). Some limited research may have been applied. The maximum allowable body fat for male Marines is only 18 percent, and the female standard is 26 percent.

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Health-Related Fitness Standards:

A Baseline Approach

Stefan Constable, Ph.D.
Chief, Performance Enhancement Division
USAF School of Aerospace Medicine

For further information, please contact:

Stefan Constable, Ph.D.
Chief, Performance Enhancement Division
USAF School of Aerospace Medicine
2602 West Gate Road
Brooks AFB, TX
78235-5252

stefan.constable@brooks.af.mil

Organizations have sought to establish standards for job candidate assignment and worker retention, in order to ensure job performance and safety. The incorporation of standards for minimal performance on tests of physical capacity should be scientifically defensible: sometimes a lofty goal! As an underlying theme in this text, the scientific process to establish defensible standards should be considered complex and varied. Therefore, it may not always be possible to achieve the desired degree of test validity. Rather, one must sometimes live with what is at least minimally acceptable/defensible. Furthermore, cost-benefit concerns and resource considerations may be overly constraining to the idealized standard outcomes. On the other hand, there are many workplace scenarios where the physical requirements of the job are often quite low, but there is still significant interest in achieving or maintaining a reasonable level fitness for all workers. This can be attributed to a variety of reasons, including personal health and appearance, everyday work efficiency, good cognitive functioning, and occupational readiness. Clearly the greatest health benefits are derived when one improves from low or very modest levels of initial physical fitness. Relatedly, this chapter has attempted to build a rationale for an ancillary approach to fitness standards development: *health-based fitness* levels.

The challenges with instituting job-specific performance tests in the military or elsewhere are identified throughout "The Process of Physical Fitness Standards Development" state-of-the art- report (SOAR). Interestingly, performance on current military fitness tests does not appear to correlate well with performance on task-specific job tests required for many military vocations. The scientific literature is now replete in supporting the strong association between physical activity/fitness and general heath, wellness and quality of life. Thus, the issue of a general or baseline fitness requirement in the workplace population or the military is twofold—*a basic level of fitness for overall health, and increased levels of fitness for improved performance for occupational and recreational activities*. Thus we postulate that health-based standards are viable as an adjunctive approach to the physical fitness standards process. There may be greater specific application opportunities for the military.

The focus of Chapter 2 is therefore to:

1. Document the specific relationship between physical activity or fitness and specific health outcomes;
2. Review exercise prescription and investigate the quantitative relationships between physical activity benefits and measured levels of fitness;
3. Identify those attempts to produce a specific, health related cut-point for the specified fitness components; and
4. Assess at least qualitatively, the validity of those heath-based fitness approaches.

More specifically, three categories (or modalities) for health related fitness have been identified as cardiorespiratory, musculoskeletal and body composition, although it is recognized that an analogous grouping termed "metabolic fitness" could also be considered. Since there are many lifestyle and environmental influences as well as genetic factors that are all related to overall health, it is also difficult to isolate *specific* types and amounts of activity for each person as direct predictors of optimized wellness. The key issue here of dose-response should be viewed as the description of how much and what type of physical activity is required to achieve health-related or specific performance outcomes. Further, the specific dose parameters (volume, intensity, modality) associated with health responses will normally be quite different that those typi-

cally identified· when the desired outcome (or response) is physical performance. Moreover, identifying the *minimal* dose-response relationships, not to mention truly testable metrics or standards, has proven the greatest challenge.

An overview of the limited attempts thus far applied for this type of approach to the process of physical fitness standards development is also given. A novel analysis by the Institute for Aerobics Research initially suggests the cardiorespiritory cut-points might be relatively low. A much clearer relationship has been identified between body composition (e.g., body mass index [BMI] correlates with fatness and is defined by weight [kilograms] divided by the square of the height [meters]) and health. While, the musculoskeletal fitness modality should prove to be the most difficult relationship to correlate with personal health. Therefore, however attractive or meritorious this endeavor may appear, the basic observation should be that in application or practice, varying levels of difficulty may be encountered, again depending on the chosen modality. This is primarily due to the general lack of sufficient data and/or discreet methodologies to identify *clearly defined cut-points* to base standards on. Nevertheless, this should not deter further efforts to apply or investigate alternative procedures. Overall, Chapter 2 of the SOAR explores the concept of baseline, health related fitness requirements with potential application to selected military and civilian environments. Also presented is the theoretical merit for this more "generic" approach to the process of physical fitness standards development and available methodological procedures and precedents.

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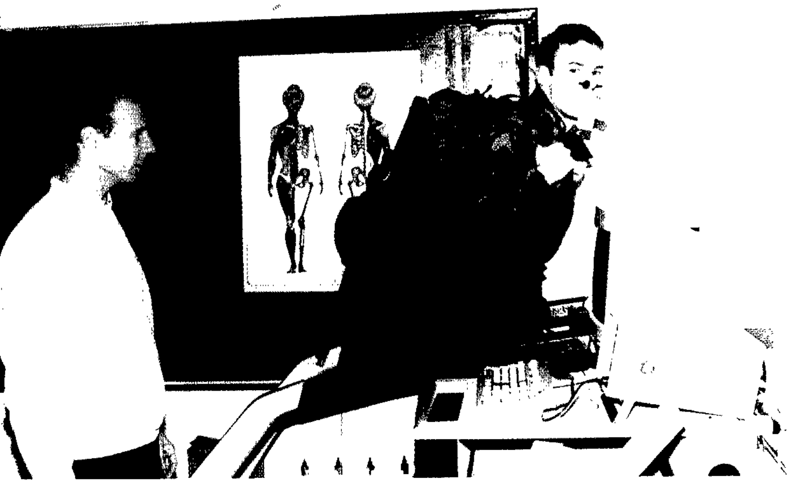

Figure 1. Mark Rayson measures oxygen uptake during simulated loaded marching in army soldiers.

Job Analysis

Mark Rayson
Optimal Performance Limited

For further information, please contact:

Mark Rayson, Ph.D.
Optimal Performance Limited
Old Chambers
93/94 West Street
Farnham
Surrey GU97EB
United Kingdom

mark@optimalperformance.co.uk

The purpose of conducting a job analysis or Physical Demands Analysis is to describe and quantify those aspects of physical fitness or physical performance that are relevant to job performance. Given the interdependencies between aspects of the job, the environment, and the employees, adopting a systems approach is essential in documenting and quantifying these elements. Job or task elements include mode, frequency, intensity and duration of a task, postures, objects, and equipment used. Environmental factors include temperature, humidity, altitude, noise, air pollution, workspace, clothing etc. The human elements include age, gender, body dimensions, for example. Conducting a job analysis should be an employer's first step to improve the integration of the human element into the system.

A number of techniques have been presented to identify the most physically demanding tasks using some industrial/organizational psychology tools, such as observation, interviews and questionnaires. Other techniques for quantifying the stress and strain associated with these tasks using physiological, biomechanical and psychophysical approaches are presented, and the strengths and limitations of the various approaches are discussed. In brief, the physiological approach appraises the strain on the cardiovascular and respiratory systems through the measurement of responses such as heart rate, oxygen uptake rate or lactate accumulation (see Figure 1). The biomechanical approach scrutinizes the forces exerted on and by the body during work. It is often used to analyze postures and the support and movement of loads and is therefore particularly useful in assessing material handling tasks. The psychophysical approach assumes that both biomechanical and physiological stresses impinge on an employee performing any task and that these stresses are integrated and combined and can be assessed as an objective measure of acceptable demand rate of repetitive work or perceived stress.

The issue of which approaches and techniques should be selected by the investigator will depend on many factors, including the nature of the job or task under investigation, the extent of financial and human resources available to support the work, and the expertise of the investigation team. In general terms, a multidisciplinary approach performed by a multi-ethnic, mixed-gender and -aged team with differing skills and perspectives is preferred, as it is more likely to elicit a complete and balanced output. The optimal team is also likely to comprise both in-house workers who are highly familiar with the jobs under scrutiny, and external consultants who can bring greater objectivity and reliability to the process.

In conclusion, this chapter presents the merits of numerous approaches for conducting a job analysis to identify and quantify the most demanding tasks. While conducting a job analysis is a complex process requiring time, money, effort, and equal measure of good science and good judgment, the results provide a solid foundation for establishing occupational fitness standards, focusing physical training programs, identifying health and safety issues, and prioritizing those tasks that require job redesign. The long-term benefit to the employer of implementing these strategies will be increased productivity through improved operational effectiveness and reduced injury. ■

Types of Physical Performance Tests

Andrew S. Jackson
Department of Health and Human Performance
University of Houston

There are two general types of tests used to evaluate a person's ability to do physically demanding work tasks. These are work sample and basic ability tests. Work sample tests are designed to duplicate occupational tasks. Physical ability tests measure common physiological constructs that include aerobic fitness (VO2max), body composition, strength, muscle endurance, balance and flexibility.

The principle advantage of work sample tests for making employment decisions is they tend to be content valid. The closer that the work sample test duplicates an important work task, the more likely that the test is content valid. While work sample tests are commonly used to make employment decisions they do have limitations. In some instances, work sample tests are expensive to create, difficult to set up and transport from one location to another. Another disadvantage is that work sample tests are often scored by pass or fail and does not give information about an individual's maximum work capacity. While two applicants may both pass a work sample test, one may have the physiological capacity to do the work while the other may be working close to their physiological capacity. A final limitation is the risk of injury is increased for applicants who lack the physical capacity to meet the demands of the task, but try their best to pass the test. The major limitation of basic ability tests is that the test measures the applicants physiological capacity; it does not duplicate the work task. To validly use a basic ability test to make an employment decision, the researcher would need to establish two interrelated conditions. First that the work task is correlated with the basic ability. Second, the level of the basic ability required to perform the task. As an illustration, it is well established that the capacity to lift materials (e.g., box) from floor-to-kunckle height is a function of the lifter's strength, but the load that needs to be lifted can vary. The strength needed to lift a 75-pound load will be greater than the strength required for a 50-pound lift.

Research confirms that physically demanding work tasks are largely dependent on the basic abilities of aerobic fitness (VO2max), body composition, and strength. The work tasks dependent upon aerobic fitness are those that require the worker to move their body weight (e.g., climbing stairs) and work for extended periods of time. A major focus of occupational aerobic fitness research has been to define the physiological capacity needed to be a firefighter. Laboratory research has shown that a VO2max of 33.5 ml/kg/min is the minimum aerobic fitness one must have to meet the demands of firefighting. The capacity to perform many different physically demanding work tasks is dependent of body composition. Percent body fat is correlated with work tasks that require the individual to move their body. Individuals with a high level of body fat have more difficulty with body movement tasks such as climbing. Fat-free mass is the source of the body's capacity to generate force. Research shows that the capacity to do strength-related work tasks are dependent upon the body's fat-free weight component. Because of an increased threat of litigation, body composition variables are rarely used for pre-employment testing in the public sector. A wide variety of work tasks have been shown to be correlated with muscular strength. While strength can be measured by isokinetic, isotonic or isometric methods, the principle method used for pre-employment testing is with isometric strength tests. Isometric strength tests have been shown to be correlated (r 3 0.63) with many different force generation and absolute endurance work tasks. The capacity to generate push, pull and lift force in a variety of body positions is dependent upon strength. Absolute endurance work tasks are those that the power-output is the same for all workers. Examples of these tasks are opening and closing valves, shoveling and transporting heavy objects. Materials lifting, one of the more common industrial tasks, is dependent on the worker's strength. Although important, the basic abilities of flexibility, balance, and agility are less likely to be related to physically demanding tasks. ■

For further information, please contact:

Andrew S. Jackson, P.E.D.
Department of Health and Human Performance
University of Houston
Houston, TX 77004

Ajackson@mail.uh.edu

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Physical Test Validation for Job Selection

James A. Hodgdon
Human Performance Center
Naval Health Research Center
Andrew S. Jackson
Department of Health and Human Performance
University of Houston

For further information, please contact:

James A. Hodgdon, Ph.D.
Human Performance Center
Naval Health Research Center
P.O. Box 85122
San Diego, CA 92186-5122

hodgdon@ngrc.navy.mil

Andrew S. Jackson, P.E.D.
Department of Health and Human Performance
University of Houston
Houston, TX 77004

Ajackson@mail.uh.edu

Reference

EEOC. (1978). Uniform guidelines on employment selection procedures. *Federal Registers, 43* (38289-28309).

The principal guidance for the design and implementation of selection tests for employment is the Uniform Guidelines on employee Selection Procedures issued by the Equal Employment Opportunity commission in 1978 (EEOC, 1978). The sanctioned validation methods are criterion-related validity, content validity, and construct validity (see Tables 1, 2, and 3).

Content validity indicates the test items reflect elements of the job. The job and test content are linked. Criterion-related validity indicates the test items are proven to be estimators or predictors of critical or important duties, work behaviors or work outcomes. Construct validity is present when selection tests are related to a general trait or set of characteristics associated with successful accomplishment of critical job behaviors.

The measurement theory used to evaluate the quality of employment tests is based on the American Psychological Association standards for validating educational and psychological tests (A.P.A, 1985; A.P.A, 1987). A major difference in physical test validation is the use of physiological rather than psychological tests. The goal of physiological validation is to define the physiological capacity needed by a worker to perform the work demanded by the task. Principal features of the physiological validation approach are the use of a physiological metric to quantify test performance and the interpretation of validity results with relevant physiological research and theory.

In physiological validation, the goal is to match the worker with the physiological demands of the job. Many factors are considered: Adverse Impact, Risk of Injury, Physiological Interpretation of the Validation Results, Environmental Conditions, Workforce Numbers, Criticality of the Job, Workforce Productivity.

It is required by the Uniform Guidelines that validity studies be conducted whenever it is necessary to continue selecting practices that lead to adverse impacts. All studies must be carried out in a responsible manner and require using good judgment in implementing selection procedures. ■

Table 1. EEOC Technical standards guidelines for the criterion validation method.

Technical Standard for Criterion-Related Validation Studies
1. The study must be technically feasible. It must be possible to get an adequate sample size to provide a scientifically sound result. However, an employer is not required to hire or promote individuals in order to be able to conduct a criterion-related study.
2. Whether the study is to be concurrent or predictive, the sample subjects should be representative of the individuals who might reasonably be expected to fill the positions being studied.
3. In general, the guidelines indicate the finding of a significance level $P \leq 0.05$ to be acceptable.
4. However, users should evaluate each selection procedure to assure that it is appropriate for operational use. In general, the greater the magnitude of the correlations found between the job behaviors and the tests, and the greater the number of job behaviors predicted by a particular test, the more appropriate it is for implementation. Selection procedures derived from studies with large sample sizes and low correlations, and sole reliance on a selection instrument that is related to only one of many critical job behaviors will be subject to close review.
5. Users must avoid use of techniques that can lead to inflated validities for selection procedures. Examples include reliance on a few selection procedures or criteria when many were studied, and use of the statistics from one sample when they may not have held up well on cross-validation. The Guidelines recommend large samples and use of cross-validation.
6. The Guidelines call for the maintenance of "fairness" in selection procedures. Essentially, unfairness results when members of one group characteristically obtain lower scores on a selection procedure than members of another group, but the differences in scores on the selection instrument are not manifest in differences in job performance. The guidelines call for investigation of the fairness of selection procedures whenever a selection device has adverse impact.

Table 2: EEOC Technical standards guidelines for the content validation method.

Technical Standard for Content Validation Studies
1. Consideration must be given to the appropriateness of content validity strategy. Such a strategy is not appropriate when the job tasks represent knowledge, skills, and abilities that an employee is expected to learn on the job. It is also not appropriate for demonstrating the validity of selection procedures that claim to measure traits or constructs such as intelligence, aptitude, personality, common sense, judgment, and leadership.
2. The job analysis must focus on the important work behaviors, their relative importance across all behaviors, and the products of such work behaviors. To be included in a work sample, the behaviors must be observable, and some aspect of them must be measurable. The work behaviors selected for measurement should be critical and/or important work behaviors that constitute most of the job.
3. To demonstrate content validity of a selection procedure, it must be shown that the behaviors are a representative sample of behaviors of the job or that the selection procedure offers a representative sample of the work product of the job. For selection procedures measuring a skill or ability, the procedures must closely approximate an observable work behavior or work product. The closer the content and the context of the selection tests are to work samples and work behaviors, the more suitable they are for showing content validity.
4. Whenever feasible, measurement of the reliability of the selection procedures should be carried out.

Table 3. EEOC Technical standards guidelines for the construct validation method.

Technical Standard for Construct Validity Studies
1. The Guidelines recognize that establishment of construct validity is a more complex strategy than either content or criterion-related validity, and that there was, at the time of Guidelines' publication, a lack of literature extending the concept to employment practices.
2. Therefore, the job analysis must be carried out in a fashion that allows the identification of constructs underlying the important job behaviors. Each construct discovered should be named and defined to distinguish it from all other constructs so discovered.
3. Selection procedures should then be developed or identified that measure the work behavior constructs. The users must then show that the selection procedures are related to the work behavior constructs and that the work behavior constructs are validly related to the performance of important or critical work behaviors.
4. The Guidelines allow limited use of construct validity studies. "Until such time as professional literature provides more guidance on the use of construct validity in employment situations, the Federal agencies will accept a claim of construct validity without a criterion-related study...only when the selection procedure has been used elsewhere in a situation in which a criterion-related study has been conducted and the use of a criterion-related validity study in this context meets the standards for transportability of criterion-related validity studies set forth above...."

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Establishing Performance Standards

Deborah L. Gebhardt, Ph.D.
Human Performance Systems, Inc.

For further information please contact:

Deborah L. Gebhardt, Ph.D.
Human Performance Systems, Inc.
5000 Sunnyside Avenue
Suite 203
Beltsville, MD 20705

hpsdgebhardt@erols.com

Reference

Equal Employment Opportunity Commission, Civil Service Commission, Department of Labor; Title 29 Code Of Federal Regulations Part 1607—"Uniform Guidelines On Employee Selection Procedures (1978)"

In the employment setting, test scores may be used to determine and predict acceptable job performance. Identification of the test score(s) that predicts whether a job candidate can perform or be trained to perform the essential job tasks is crucial to the selection of qualified workers. Several methodologies can be used to establish passing scores for tests.The methodology employed depends upon the type of validity strategy used in the validation study. Typically content and criterion-related validity are used.

The requirements for identifying passing scores are addressed. These are referred to by a variety of names such as minimum test score, cutoff score, cut-score, performance standard, and passing score. The term passing score is used to refer to a test score that is indicative of acceptable test performance.

To establish a job-related passing score that identifies successful and unsuccessful candidates, accurate test (predictor), job performance (criterion), and ergonomic/physiological data are needed. Criterion measures assess different levels of job performance and are coupled with test scores and validity coefficients to determine a passing score. These components are also used to assess whether the passing score maximizes the correct hiring decisions and minimizes testing errors.This is accomplished through the use expectancy tables, contingency tables, and Taylor Russell tables [According to Taylor and Russell, there are three important factors to consider when judging the validity of a selection test: (a) the correlation between the test score and job performance, (b) the base rate of success on the job, and (c) the selection ratio].The use of ergonomic, physiological, and normative data for setting standards is also discussed in relation to identifying an accurate passing score.

Issues related to test fairness and adverse impact, and their integration with legal requirements are highlighted. The impact of basic physiological tests (e.g., aerobic capacity, strength test) and job simulations on the reduction of adverse impact is addressed by using comparisons from a variety of physical performance validity studies. Finally, the computation of test fairness is described, along with its relationship to adverse impact and test utility.

Table 1 shows an example of a graphic rating scale used in a validation study to assess selected aspects of job performance (criterion measure) for use in deriving the validity coefficient in a criterion-related validity study and to determine whether a specific test score accurately identified individuals whose job performance was acceptable. The integration of data from multiple sources (e.g., test score, criterion measures, ergonomic, physiological, hiring ratios) is used in conjunction with expectance table, contingency table, and Taylor Russell tables to establish an accurate passing score that will reflect future job performance. Finally, these data are combined with issues such as test fairness and adverse impact to ensure accurate employment decision and compliance with EEOC Uniform Guidelines on Employee Selection Procedures (1978). ■

Table 1. Graphic rating scale examples

Scale 1
5 = Above average
4 = Slightly above average
3 = Average
2 = Below average
1 = Poor
Scale 2
5 = Greatly exceeds job requirements
4 = Exceeds job requirements
3 = Meets job requirements
2 = Meets minimal job requirements, with assistance
1 = Does not meet job requirements

Legal Issues Related to [illegible]

Andrew S. Jackson
Department of Health and Human Performance
University of Houston

Title VII of the Civil Rights Act of 1964, the Age Discrimination in Employment Act (ADEA) of 1967, and Americans with Disabilities Act (ADA) of 1990, are the federal laws that define discriminatory employment practices. The centerpiece of employment discrimination law is Title VII of the Civil Rights Act of 1964, as amended by Congress on several occasions. Title VII prohibits employment discrimination because of "race, color, religion, sex, and national origin" by employers, labor organizations, and employment agencies. Title VII tends to be comprehensive in that everyone is potentially covered, because both genders and all majority and minority racial and ethnic groups, as well as religious groups, are covered by Title VII, but the act does not apply to Military personnel.

In determining whether applicants are capable of performing required job tasks has been the main force behind a multitude of tests used by employers to predict job performance. When physical tests are used to determine employment a company must be very careful to judge that the test is valid, necessary for the job at hand, and does not discriminate against a protected group.

The disparate impact theory is used to establish employment discrimination. This legal process has a three-part burden of proof. First, the plaintiff (employee) must establish that the hiring practice has a disparate impact on a protected group. Although not legally mandated, the Equal Employment Opportunity Commission (EEOC) Guidelines are often used to define disparate impact. The guidelines use the four-fifths (4/5s) rule to define adverse impact. Under the 4/5s rule a selection device has adverse impact when the pass rate for one protected group is less than four-fifths, or 80 percent, of the pass rate of the group with the highest pass rate. Once adverse impact is established, the burden of proof then falls on the defendant (employer) to justify that the exclusionary effect is a business necessity. The defendant must show that the selection method is job related. This involves demonstrating that the selection device (e.g., preemployment test) is valid. A common method used to establish job relatedness is with a validation study. Lastly, if business necessity is established, the burden of proof shifts back to the plaintiff to demonstrate that the employer failed to use a selection device that is equally effective but has a lesser disparate impact.

Many legal cases are related to physical testing and involved the use of height and weight standards and tests for selecting public service employees such as police officers and firefighters. The outcome of the litigation largely depends on the scientific quality of validation study. The recent court ruling of Lanning versus SEPTA (U.S. 3rd Circuit 1999) will likely have a major impact on physical testing. This case addresses the physical condition of police officer candidates and the use of a VO2max test to measure aerobic capacity. An aerobic fitness cut-score representing a VO2max of 42.5 ml/kg/min was found to be unacceptable by the court. An option offered by the U.S. 3rd Circuit Court was the validation of an aerobic fitness cutoff score that measures the minimum capacity necessary to perform the job. In the remand of the case from the U.S. 3rd Circuit Court and based on Findings of Fact and Conclusions of Law, the U.S. District Court for the Eastern District of Pennsylvania ruled that SEPTA met its burden of establishing the business necessity of its aerobic capacity standard of 42.5 ml/kg/min. Central in the Court's decision was the rejection of the common practice of setting a cut-score on a physical ability test one standard deviation below the average incumbents. The Court recognized the need to define the minimum aerobic qualifications needed to perform the job, which for SEPTA officers was a minimum aerobic capacity of 42.5 ml/kg/min.This ruling is consistent with established physiological and ergonomic principles of selecting workers with the physiological capacity demanded by the job. This suggests that validation studies will not only be evaluated by standard psychometric test validation criteria, but also by physiological validation methods. Physiological validation involves identifying the physiological abilities that are correlated with critical work tasks and then defining the minimum physiological level needed to meet the demands of the task. The complexity of many work tasks suggests that the physiological validation process is a multivariate procedure.

For further information, please contact:

Andrew S. Jackson, P.E.D.
Department of Health and Human Performance
University of Houston
Houston, TX 77004

Ajackson@mail.uh.edu

HSIAC
ARMY NAVY AIR FORCE NASA FAA NATO

PROGRAM OFFICE
AFRL/HEC/HSIAC BLDG 196
2261 MONAHAN WAY
WRIGHT-PATTERSON AFB OH 45433–7022

[illegible]

(937) 255–4842 Telephone
(937) 785–4842 DSN
(937) 255–4823 Facsimile
(937) 255–2558 Gov. Tech Manager

Thomas Metzler, *Director*

Dr. Michael Fineberg, *Chief Scientist*

Dr. Joe McDaniel, *Gov. Technical Manager*

Tanya Ellifritt, *Assoc. Gov. Technical Manager*

Dr. Kenneth R. Boff, *Gov. Technical Director*

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RoseAnn Venis, *Editor*
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